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ABSTRACT

This document contains four papers from a symposium on assessing employee skills. "Bridging the Training Gap: Identifying Work Place Transferable Skills Needs in Manufacturing Organizations in East Central Minnesota" (K. Peter Kuchinke, James M. Brown, Howie Anderson, Joe Hobson) reports a study of a workplace education program in rural Minnesota that examined the following: nature of the study organizations' training needs, expectations of production-level trainees, experiences of the program staff, and the nature of public-private collaboration. A diagnostic study of the learning network and work performed in a Dutch service organization is detailed in "Diagnosing the Learning Network in a Changing Organization" (Ferd J. Van der Krogt). "Employee Efficacy Generalization of Basic Mathematics Skills" (Alan J. Coleman, Patricia E. Boverie) discusses a quasi-experimental study demonstrating that, as individuals are given the opportunity to develop their basic mathematics skills, their perceptions of their own ability for skills associated with personal and work-related daily activities increase as well. The process used to develop a writing test for technical writers in a high-technology company is described in "A Case Study of the Feasibility of Developing a Writing Test for Hiring Technical Writers and Instructional Designers" (Rosemarie J. Park). (MN)

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34 **Assessing Employee Skills**

Chair: David Frantz, Purdue University

Bridging the Training Gap: Identifying Work Place Transferable Skills Needs in Manufacturing Organizations in East Central Minnesota
K. Peter Kuchinke, University of Minnesota
James M. Brown, University of Minnesota
Howie Anderson, Pine Technical College
Joe Hobson, Pine Technical College

Diagnosing the Learning Network in a Changing Organization
Ferd J. Van der Krogt, University of Nijmegen

Employee Efficacy Generalization of Basic Mathematics Skills
Alan J. Coleman, Ethicon, Inc.
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A Case Study of the Feasibility of Developing a Writing Test for Hiring Technical Writers and Instructional Designers
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Bridging the Training Gap: Identifying Work Place Transferable Skills Needs in Manufacturing Organizations in East Central Minnesota

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This study reports on the results of one work place education program in rural Minnesota where significant formative findings and insights have resulted regarding the nature of the training needs among the participating organizations, the expectations of the production-level trainees, the experience of program staff, and lastly regarding the nature a private/public collaboration. These results contribute to the better understanding of the requirements for successful job skills programs, and pave the way for improved program planning and implementation.

The role of an educated and trained workforce for the economic well-being of individual organizations and the country as a whole has received much attention over the past 15 years. Beginning with reports of declining high school students' scores on standardized test in the early 1980s (National Commission on Excellence in Education, 1984), many of the recent school reform efforts have focused on providing students and employees with the skills, knowledge, and attitudes required to perform in a fast-paced, rapidly changing technological economic environment.

Research has shown a clear correlation between the employees' level of basic workplace skills and their productivity in the workplace. Increased workplace basic skills lead to more instances of employees using reading and writing on the job, higher employee participation in meetings, employees asking more questions and making more suggestions, improvements in job attendance and safety, and significant gains in supervisory ratings (for a summary: Bergmann, 1995)

Estimates of the percentage of employees with insufficient levels of basic skills range from 20 to 40% (Bergmann, 1995; National Center for the Educational Quality of the Work Force, 1995), and this problem is expected to worsen as new labor market entrants will come increasingly from economically disadvantaged populations who traditionally have had poor success in school and inadequate access to formal education (Hull, 1991). As a result vocational educators and business owners alike have become involved in workplace-based basic and/or transferable skills programs. According to the annual industry training report, a nation-wide survey of over 13,000 private organizations in the United States (Training, 1995), one-third of companies' training budgets $17.3 billion in 1994- is spent on training for production workers, service workers, and administrative employees. Thus, one in five organizations with 100 or more employees provide basic skills training, and this training is focused on the three "Rs": basic math (40% of companies providing training), Writing (37% of companies), and Reading (37%). Twenty seven percent of companies also provide training in English as a Second Language (Training, 1995).

Given the size of the training effort and the scope of the problem of insufficient skills among the incumbent workforce, measures to identify the skills gap, provide the requisite education and training, and improve public education as a feeder system for future workforce entrants. The literature contains a number of reports on basic skills needs assessment projects, for instance in the mining sector (Cole, 1994), among manufacturing employees (McKeag, 1993), and among carpenters, joiners and construction workers (McKeag, 1994).

This study reports on the results of one such workplace transferable skills program in rural Minnesota. The project, begun in the fall of 1995, is currently in its second year, and has moved beyond the needs identification and assessment phase into the implementation stage of training. While the summative evaluation of the project will occur once the project is completed, significant

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formative findings and insights have been produced that focus on: (a) the nature of the training needs among the participating organizations, (b) the expectations of the populations of trainees, (c) the experience of program staff, and (d) the nature of private/public collaboration. These formative results, perceived from the vantage point of the external evaluators to the project, contribute to the better understanding of the requirements for successful job skills programs and pave the way for improved program planning and implementation.

Project Overview

The Human Resource Development Partnership Project (HRDP) is a collaboration between a Technical College in East Central Minnesota, a group of local manufacturing organizations, the Minnesota Job Skills Partnership (a division of the state's Division of Trade and Economic Development), and staff at the University of Minnesota. The HRDP is a direct result of activities initiated by the East Central Minnesota Labor Force Committee and subsequently, by joint efforts with the Manufacturer Educational Committee in the area The major objectives of the project were to identify the job functions, assess the level of present workforce members, to modify present curriculum to meet the needs of business and industry, and to provide training to current and future workforce members. The rural setting context added significance to the project. The vast technological changes in American business and industry have been well documented, as have the resulting need for a new educational paradigm with a "system of credentialing that communicates real information no matter where the learner is in age, educational level, or geographic location" (Ferguson and Maxey, 1976, p. 4). If these needs are pressing for urban settings, they place even greater burdens on rural areas that are characterized by low population density, a preponderance of single industries, and lack of access to the educational opportunities typically available in metropolitan settings. In contrast to other rural areas in the state, however, East Central Minnesota, because of its proximity to the metropolitan Twin Cities areas, is expected to experience the fastest rate of growth in Minnesota's six regions in six of eight occupational groups, and in manufacturing employment in particular. Nearly three-fourths of manufacturing job growth will be in durable goods industries, especially lumber and wood products, electronic equipment, and fabricated metal products. The demand for adequately skilled workers, however, is expected to outpace population growth rates in this region. While demographic information shows a 51% increase in the labor force demands between the years 1990 and 2010, the population of East Central Minnesota is expected to grow at the slower rate of 42% during the same period (East Central Minnesota Labor Force Committee, 1996). Against this background, the HRDP was initiated and a project vision focused on "developing partnerships to identify, create, develop, and maintain a qualified labor force for East Central Minnesota" was developed. The project was formally inaugurated at a grant signing ceremony in September 1995, when a grant from the Minnesota Job Skills Partnership was awarded jointly to the local Technical and Community College for training and development of six participating local businesses which, in turn, had pledged varying amounts of direct and in-kind contributions to the project.

Description Of Participating Businesses Six small, family owned businesses participated in the HRDP with a total workforce of 412 employees. The number of participating workers in individual businesses ranged from less than 20 to 150 employees. The participating businesses, located within a radius of 50 miles from the Technical College, are in the light manufacturing metal or plastics fabrication industry, and enjoy a high level of familiarity, openness, and collaboration with one another, despite the fact that several compete directly with one another. The job classifications of the potential trainees included welders, tool-and-die makers, machinists, and related jobs. The group consisted of 354 present and 58 new employees and apprentices. Hourly wages for these jobs ranged from $6.00 to $17, with an average pay of $9.96 per hour (excluding premiums and overtime pay).

Project Implementation: Communications

Early on in the project, leadership recognized that the success of this project, which involved multiple stakeholders over a large geographic area, depended on timely and effective communication and sharing of relevant information. This was assured in a number of ways: regular, bimonthly breakfast meetings, organized by Technical College staff and attended by participating and prospective new employers, college staff, state representatives, and the external evaluators served as the most formal and visible forum for disseminating information,. These meetings provided project updates, answered questions and addressed concerns as they arose during implementation of the project. Project staff were in systematic, ongoing formal and informal communication with the participating business owners and their employees. The external evaluators provided quarterly informal and biannual formal project status updates, providing feedback and formative evaluation overviews to project leadership and the sponsoring state agency regarding both the implementation process (such as adherence to the implementation schedule, need for revisions of project plan), and the quality of the implementation as assessed through stakeholder interviews, surveys, and other formal and informal means.

Assessing Stakeholder Needs And Expectations: Business Owners Early on, this project's leaders committed themselves to a broad-based needs assessment approach, systematically involving and gathering information on the needs of three major stakeholder groups: employers, employees/trainees, and project staff relative to the implementation of the HRDP. Only an approach that balanced the expectations of each group considered appropriate. Although an initial assessment had been conducted during the planning stage of the project, and was indeed the basis for the project plan, a more extensive assessment was conducted during the implementation phase of the project. This included determining the needs and expectations of business owners and employees and identifying critical gaps in employees' abilities to perform as expected on their jobs.

In order to identify the expectations of participating employers, a roundtable discussion meeting was convened by the external evaluators shortly after the beginning of the project. These businesses' Chief Executive Officers (CEOs) were asked to identify the project's critical success-related factors and to envision the end state of a successful HRDP. Table 1 lists the expectations specified by the business owners, which, not surprisingly addressed primarily competitive issues related to the economic positioning of their businesses through enhanced performance of their employees.

Table 1
Employer Objectives for Training (ranked by frequency), N=5

1.	Increase gross profit
2.	Increase productivity
3.	Reduce rework/reject rate
4.	Increase job satisfaction
5.	Reduce turnover
6.	Improve flexibility of workforce
7.	Improve quality of decision-making processes
8.	Improve collaboration and motivation
9.	Improve product quality

Not surprising, given the small to moderate size of participating businesses, only the most fundamental accounting data were available and being collected on a regular basis at the time of project start-up. A major challenge to the effective evaluation of the project, therefore, was the development and implementation of key performance indicators that would allow the owners and evaluators to measure changes associated with the project. In some instances, such as worker turnover rate, data were readily available and could be obtained without difficulty. In fact, as a result of the HRDP, an informal collegial network was developed among the business owners and key project staff members. This network facilitated cross-training and bench marking among participating businesses. In other instances, the group is still in the process of identifying and operationalizing ways of measuring processes and outcomes, such as "improving the quality of decision-making processes."

Perhaps most clearly recognizable factor was the high level of commitment by the owners/CEOs to improving the overall capacity of their employees. These business representatives agreed to seek to: (a) enhance the development of their employees, (b) collaborate with one another to master the challenges of operating small businesses in rural settings, and (c) improve the quality of the educational offerings provided by local public institutions by making their needs known and by participating in training-related decision-making processes. Such a long-range perspective was meaningfully expressed by one business owner who, when asked for his main reason for participating in the project, stated that his main interest was to ensure that 10 years down the line that the Technical College would have a more relevant and focused curriculum in place where he could send his employees for training and retraining and recruit new workers.

After determining the expectations of the business owners as a group, it was agreed that project staff would work with each business individually just prior to commencement of training to determine a small number of relevant key indicators, making use of already existing measures, and coordinating the development and implementation of such measures where none existed. Using a pre/post approach, business level indicators are measured before the onset of training and again six months after completion of the training has been completed to assess the potential impact of the training intervention at the business level.

Assessing Stakeholder Needs And Expectations: Employees Assessing the training needs and expectations of employees was a key component of efforts to assure that training interventions would successfully achieve the objectives of the business owners, as well as meeting the needs of current employees. A two-pronged assessment strategy was employed. To measure gaps between job skill requirements and corresponding skill levels of workers, the HRDP used the Work Keys system developed by American College Testing (ACT). To asses the level of training readiness and related motivational components, a survey was administered to incumbents and small group discussions were conducted by trained facilitators. The resulting information are now used to tailor the training to the needs of the employees, they also as a baseline measure that will allow for assessment and evaluation of the effectiveness of the training.

Training Needs Assessment Work Keys is a proprietary training system developed by ACT in the early 1990s to address "those workplace skills which apply to a wide range of jobs, are teachable in a reasonable period of time, and can be defined for purposes of job analysis" (ACT, n. d.). The system consists of four integrated components, Job Profiling, Assessment, Training, and Evaluation.

The Work Keys system has received much attention in the research literature in recent years: the psychometric properties of two of the eight scales were validated with over 6,000 high school students and adult employees by Vansickle (1992), and two others by Brennan (1995); a summary of all available validation studies is available from the publisher (ACT, 1996). The system has been adopted by several states, among them Ohio, whose vocational competency assessment program (OVCA) is based on the Work Keys system and has resulted in a library of job profiles for 39 occupations (The Ohio State University, 1995). The profiling and assessments of employee competence is conducted in three dimensions: PROBLEM SOLVING SKILLS (Applied Mathematics, Applied Technology, Observation), Communication Skills (Reading for Information, Writing, Listening, Locating Information), and Interpersonal Skills (Teamwork).

The results of the needs assessments conducted by trained assessors with the initial group of five companies (109 incumbents assessed) resulted in the following distribution (Table 2) of training needs. The results of the needs assessment indicate that, as a group, 84% of the employees needed some form of remedial training, with individual companies ranging from 69% (Organization D) to a high of 95% for Organization A. The largest training needs were in a cluster made up of Observation Skills (48% of employees needing training), Applied Technology (45% of employees needing training), and Locating Information (39% of employees) needing training. Reading for Information and Applied Math were the two lowest skill areas with 20% and 18% of employees respectively needing some form of training to meet the requirements of their job. Overall, there was a significant difference of training needs among the eight subject areas ($F=10.50$, 8/91 d.f., $p \leq .001$).

Table 2
Results of Skill Assessment (N=109)
(Number of Employees needing Training/Number of Training Units)

Org.	Number of Employees Assessed	Read Employ/Units	Math Employ/Units	Info Employ/Units	Tech Employ/Units	Observ Employ/Units	Team Employ/Units	Writing Employ/Units	Listening Employ/Units	Sum Employ/Units %
A	20	3/6	5/8	13/17	12/20	12/12	11/15	7/8	14/15	19/101 95%
B	17	1/1	3/3	1/1	3/3	12/13	2/2	0	n/a	13/23 76%
C	9	1/1	0	3/3	4/4	3/3	1/1	8/9	0	8/22 89%
D	37	12/15	9/12	20/37	24/34	17/27	20/30	11/20	14/23	34/208 92%
E	26	5/6	3/4	6/7	7/13	10/13	0	10/14	3/6	18/63 69%
SUM	109	22/29	20/27	43/65	50/74	53/68	34/48	36/51	31/44	92/417
Avg %		20%	18%	39%	45%	48%	31%	33%	28%	84%
Avg # person units		.27	.25	.60	.68	.62	.44	.48	.40	3.82

Key: Read: Reading for Information; Math: Applied Math; Info: Locating Information; Tech: Applied Technology; Observ: Observation; Team: Teamwork; Writing: Writing; Listening

Training Readiness and Motivation for Training. *In* addition to assessing the cognitive skill needs of the incumbents, the project's leaders also decided to address attitudinal and motivational concerns that may facilitate the acceptance of training by the employees. This approach was based on an understanding of trainees as active participants in the education process, whose early involvement in planning was crucial for the success of the project. This approach contrasts with other needs assessment methodologies, such as Swanson's (1995) Training for Performance System, which fails to explicitly focus on the needs, expectations, and concerns of the future trainees as an important group of stakeholders in the process.

A three-pronged approach was used to determine attitudinal and motivational issues among the future trainees prior to the commencement of training. First, a short written survey was administered that probed for levels of satisfaction with key aspects of the present work situation. According to established job satisfaction literature, general job satisfaction and satisfaction with pay, co-workers, supervisors, training, the work itself, and opportunities for promotion were assessed to determine a pre-training baseline level of satisfaction among the employees.. The results of this survey are summarized in Table 3.

Table 3
Employee Pre-Training Satisfaction Levels (N=55)
(4 = high, 1 = low)

Organization	General Job Satisfaction mean, sd	Satisfaction with Pay mean, sd	Satisfaction with Co-Workers mean, sd	Satisfaction with Supervisor mean, sd	Satisfaction with Training mean, sd	Satisfaction with Work mean, sd	Satisfaction with Promotion mean, sd
A (n=17)	2.98, .34	2.82, .35	3.11, .49	2.97, .54	2.68, .43	3.0, .10	2.31, .48
B (n=6)	2.44, .27	1.67, .52	3.42, .80	2.17, .98	2.75, 4.2	2.92, .20	1.83, .26
C (n=6)	2.78, .27	2.0, .45	3.08, .20	2.58, .49	2.75, .42	2.67, .68	2.5, .45
D (n=13)	2.77, .35	2.1, .46	2.95, .44	2.5, .41	2.45, .37	2.75, .35	2.35, .58
E (n=13)	2.58, .49	2.11, .65	3.11, .58	2.73, .56	3.0, .60	2.61, .58	2.46, .80
All (N=55)	2.76, .29	2.28, .45	3.11, .37	2.68, .44	2.72, .34	2.81, .34	2.32, .42

As depicted in Table 3, the highest levels of facet satisfaction are with the work itself and with the co-workers, while the lowest levels of satisfaction were reported with opportunities for promotion. There were statistically significant differences in satisfaction scores among the five companies ($F=2.546$, 4,44 d.f., $p<.06$).

The questionnaire also assessed the level of motivation for training. The overall level of motivation was high, ranging from 2.94 to 3.39 cn a 1-4 Likert scale, and there were no significant differences among companies.

Employees were also asked to respond to three open-ended questions about their criteria for determining if they perceive training to be successful ("The training will be a success for me if..."), specific concerns related to the training ("If there is one thing that makes me nervous about this training, it is that..."), and suggestions for training delivery ("The most helpful thing that the trainers could do to help me learn better is..."). A content analysis of the answers to these questions yielded a surprisingly large amount of information that augments the quantitative data. Tables 4 summarizes answers to the question about how employees visualized successful training. While the majority defined success of the training in terms of their increased contribution to the company, an equal number asked for training that was easy to comprehend, useful to their particular job, and structured in a way that would help them succeed. The second most frequent group of responses focused on the expectation that successful training should result in increased pay and promotion opportunities within their current place of employment. Lastly, a smaller number of employees suggested that the benefits of training should go beyond their present employment settings and, thus, increase their overall marketability in the related job market.

Table 4
Themes to open-ended question: " The training will be a success for me if..."
(61 responses overall)

Theme	Frequency/%	Examples
Improve job performance and proficiency	19 31%	...if I become more efficient in my job ...if get better knowledge of required skills .... training is useful for my job
Training leads to increase in pay and opportunities for promotion with present employer	19 31%	...if I get compensated accordingly ...if I get a promotion and a raise ...if I get a better position with my company
Training leads to increase general career marketability	6 10%	... if I can go anywhere in the job market ...if training is useful for my future job ... if I better myself through education

The second open-ended question addressed fears that employees might have with respect to training. As Table 5 shows, the majority were concerned that training might be too general and not specific enough to their present job requirements. This is a serious concern in light of the general nature of transferable skills training. Only slightly behind the concern about insufficient relevancy was the fear of personal failure in completing the training. As became clear from the survey comments, a large number of incumbents appear to have had negative experiences in the public school system and now fear that problem will recur during training. The third broad theme in this category was the pronounced fear that the test results would be used against employees by their employers and would negatively impact their futures with their employers. This fear persists despite the fact that the assessment procedure clearly specified that test results were confidential and would not be disclosed to the employers, other than in aggregate form that would prevent the identification of specific individuals.

Table 5
Themes to open-ended question:
" If there is one thing that makes me nervous about this training, it is that..."
(35 responses overall)

Theme	Frequency/Percent	Examples
Training not useful	14 40%	...that the training may not be focus on the exact skills I need ...that the training will be too academic. ...that the school will benefit more from the training than the my company.
Fear of learning	12 34%	...it will be intense like high school and I won't complete it. ...you have to be a good reader to complete the training ....there'll be too many tests and problems
Lack of trust in employer	8 23%	...my employer will find out what my score is and this will effect my job. ...I might get fired if I do not do well. ...results of testing will go against me.

The final open-ended question probed for any training improvement suggestions by incumbents that might enhance their success in training programs . Here a large majority focused on useful, easy-to-comprehend, and hands-on training content, along with the need for visual materials, and careful timing and suitable location for the training.

Conclusions

Prior research has clearly established the relationships between workers' job-related skills and their productivity levels. Unfortunately, approximately one-third of the workforce has levels that have been estimated to be inadequate for their jobs' skill requirements. The high priority assigned to overcoming these skill deficits is substantiated by the $17.3 billion that businesses are estimated to have spent on training efforts during 1994.

This project represents one of the few cases where required job-related skills were actually measured instead of estimated. By measuring required job-related skills and corresponding worker skills, it was possible to identify training needs and thus, determine the type and level of training need and to establish a baseline for assessing training effectiveness.

As a group, 84% of the targeted workers were found to need additional training in one or more of the skills areas examined. Surprisingly, the skill areas related to the greatest training need levels were not related directly to reading and math (as the popular press would lead us to assume). In fact, these skill categories consistently had the lowest identified training needs associated with them. Surprisingly, there was a consistent need for the most training in the WorkKeys categories labeled Applied, Technology, Observation Skills, and Applied Math. These differences in training needs were statistically significant .

When targeted employees' attitudes and motivational traits were surveyed, it became clear that these employees' viewed their upcoming training as a resource for: (a) improving their job performance and proficiency, (b) increasing their pay and opportunities for promotion with their current employers, and (c) increasing their general career growth and marketability with other potential employers.

When employees were surweyed to identify their fears regarding the negative aspects of training that they wanted to avoid. three themes were identified. These employees were concerned that: (a) training would not be useful or practical in relation to their jobs, (b) training activities would be too difficult for them to succeed, and (c) employers would access their training scores and use that information to the disadvantage of the trainees. Clearly, these issues cannot be avoided and must be accommodated when training is designed, developed, promoted, and implemented.

These employee concerns could be attended to by being attentive to the suggestions provided during a survey of the "most helpful things that trainers could do to help trainees learn better during training". The key findings of that survey encourage trainers to: (a) provide concise and practical training curriculum, (b) use training materials and strategies that are very visual and hands-on, and (c) schedule training activities at times and locations that meet the needs and interests of the trainees.

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Diagnosing the Learning Network in a Changing Organization

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The learning network theory offers a framework (in terms of content and procedure) for the diagnosis and improvement of learning networks in organizations. This theory holds that there is a correspondence between (changes in) the organization of learning networks and (changes in) the work performed in companies and organizations. This article reports on a diagnostic study of the learning network and the work performed in a Dutch service providing organization. It is concluded with suggestions for application by HRD executives.

An organization (Dos) which gives counselling to students and educational institutes in issues related to the connection between education and employment (and which advises large numbers of students on their choice of school and career) is confronted with drastic changes taking place in its environment. The market is changing and the financing of the institute is soon to undergo a fundamental change. Dos will have to reorganize its work and adopt a more systematic approach to the learning and training of their employees, i.e. their careers advisers.
Researchers from the University of Nijmegen were asked to make a diagnosis of Dos. They opted to take the learning network theory as the basis for their analysis. This theory states that there is a relationship between (the changes in) the work on the one hand and (changes in) the organization of the learning network on the other.
In this paper I will first briefly introduce the learning network theory, then discuss the research questions and the methodology of the research and finally outline the results and the interpretation. This research project has brought in a number of insights that can have great significance for diagnosing organizations in terms of learning; these are outlined in the final section.

The Learning Network Theory: Learning Networks and Work in Organizations

In the learning network theory (Van der Krogt, 1995), a network approach to organizing is applied to learning systems. This means that an organization is conceived of as a network of actors who undertake actions in interaction and thus shape the structure (Nohria, 1992). Organizations are seen as networks (Baker, 1992), in which there are two (sub-)networks that are especially important for the issue at hand: the learning network and the work network. We will concentrate here on the learning networks and make only a few remarks on the work network.

Learning networks and actors. Learning activities (and work activities) take place in *networks*, that is to say more or less durable structures of cooperation between actors within and around organizations, set up to tackle certain problems and achieve certain goals. The term *actor* should be understood in a broad sense (Brinkerhof & Gill, 1994). It is not only trainers and managers who serve as actors in learning networks, but other groups and organizations as well, including for instance training counsellors, course developers, middle managers, personnel department staff, foremen, buyers, suppliers and the employees, i.e. the learners themselves. Moreover, actors can come from within or outside the organization - think, for instance, of external training advisors and educational institutes.

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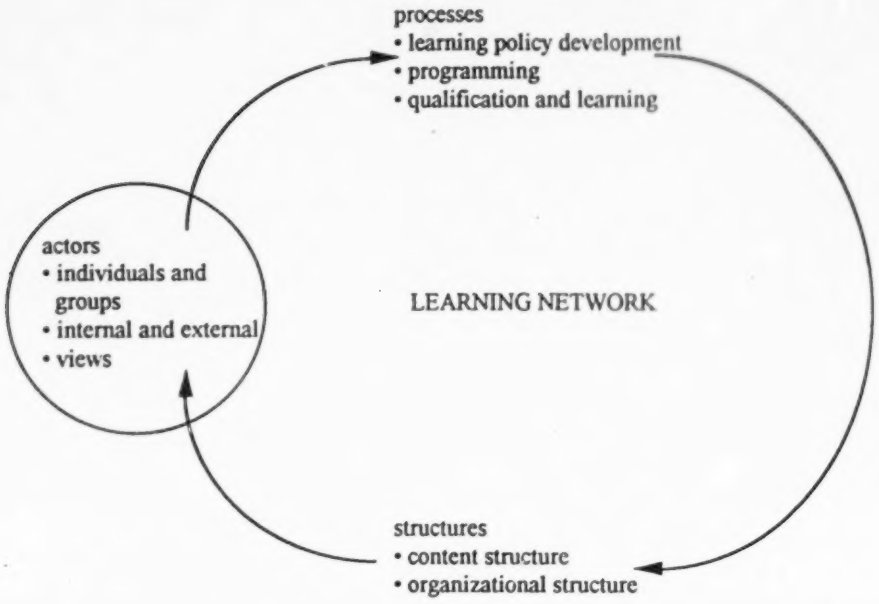
Figure 1: learning network with actors, processes and structures

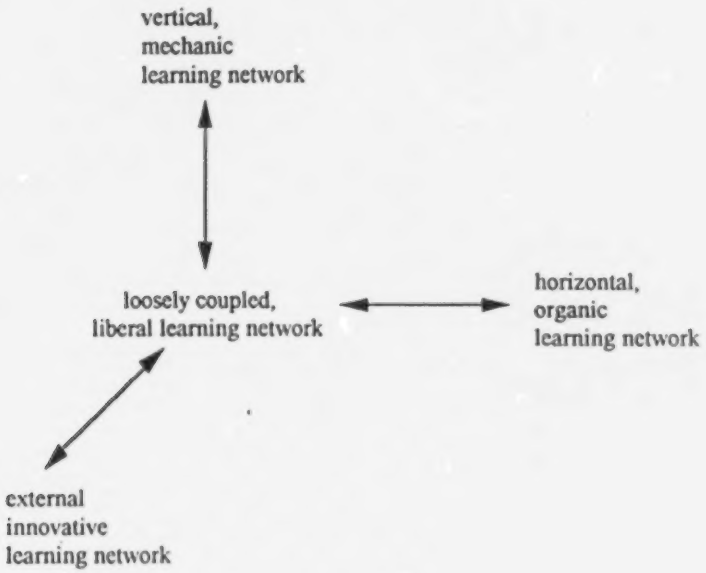


Learning networks: structure, culture and processes. Learning networks (like work networks) have a certain *structure*. Firstly an organizational structure, that is to say a certain division of tasks, responsibilities and authority among the participating actors. Secondly the content structure, comprising the whole of the learning situations (formal and informal, on- and off-the-job) available to the actors in order to create learning programs (Jacobs & Jones, 1995; Marsick & Watkins, 1990). Learning networks can also be analysed in terms of their *cultural aspects*, comprising such elements as the values and norms, the views and rules on which the actors base their actions.

Within these structural and cultural frameworks, the actors continually work together to shape the three *main processes* of the learning network: the design of learning policy, the development of learning programs and carrying out learning activities (qualification and learning).

Development space and dimensions. Learning networks are not static but constantly evolving structures of cooperation. The actors are important motors of the *development* of learning networks.

Figure 2: three-dimensional space for the analysis of learning networks, types of learning networks and development lines



Learning networks can develop in different directions, which can be visualized by means of a three-dimensional space, the three dimensions being:

- a vertical dimension, representing the extent to which the processes are steered from above, by management. A development of the learning network along this dimension implies a strengthening of hierarchical control by means of policy plans, formalized training programs and strict guidance of course participants. Taken to its extreme, verticalization can lead to a hierarchical, mechanically organized learning network.
- a horizontal dimension, representing the extent to which the processes in the learning networks are steered from below, by groups of members of the organization. A strengthening of this dimension implies a development of shared views on training and learning and an intensification of group cooperation on the programming and implementation of learning trajectories. Taken to its extreme, this dimension will create a horizontal, organically organized learning network.
- an external dimension, representing the extent to which the processes are steered from the outside, by external actors. Development along this dimension implies greater influence of organizations such as R&D institutes, trade organizations and training institutes on the development and implementation of learning programs. The extreme type on this dimension can be referred to as the external, innovative learning network.

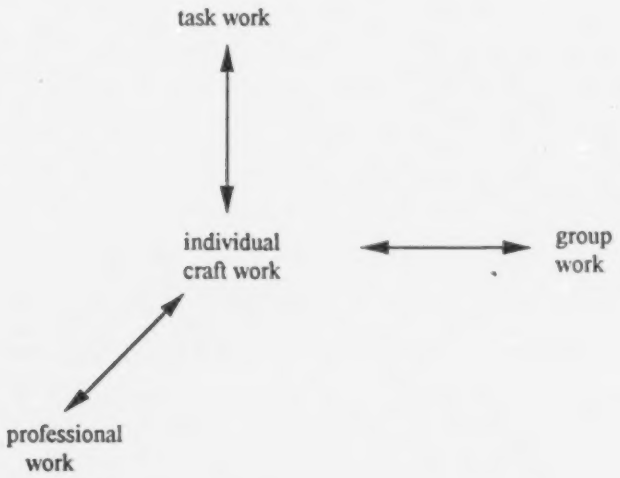
In addition to the three above-mentioned development lines, a *fourth direction of development* can occur, namely the 'liberalization' of the learning network. This development implies a weakening of the vertical, horizontal as well as external dimensions, giving the individuals greater freedom to develop learning trajectories and undertake learning activities independently, on the basis of their own views and needs. In its extreme form, the resulting learning network can be typified as a loosely coupled, liberal/individualist learning network.

Differences between learning networks. The three-dimensional space also allows us to take 'snapshots' of learning networks by determining their position along the three dimensions at any given time. An existing learning network in an organization will only rarely correspond with one of the four possible extreme types (and so be situated on the extreme end of one dimension);

combining elements of all four dimensions, it will generally be located at a certain point in the space in between the dimensions.

Work networks in organizations. Like the learning network, the work network can also be organized in a wide variety of ways. The different work networks can also be visualized by means of a three-dimensional space.

Figure 3: Work network in a three-dimensional space



(Explanation: The different types of work are defined in accordance with Mintzberg's typology (1989). In machine organizations, the work in the primary process is organized along the principles of Taylorist jobs; in the adhocracy group work is the dominant work form in the primary process; in professional organizations the work is structured along the principle of professional work, while in the entrepreneurial organization operative work is structured as individual craft work.)

General work hypotheses. Organizations with certain types of work are expected to also tend to have certain types of learning networks (compare Figures 2 and 3). It is also assumed that there will be a certain degree of correspondence between the changes taking place in the work performed and those in the organization's learning network. The correspondence between the work and learning networks is due to the fact that both networks form part of the same more comprehensive organizational network and the fact that work actors also participate in the learning network. On the other hand, learning networks cannot be expected to fully coincide with work networks in view of the nature and the specific technology employed in learning processes.

Research

The Dos organization is undergoing a change. The diagnostic study aimed at identifying the changes taking place in the work performed and in the learning network and establishing whether the learning network at Dos supports the workers in coping with these changes. Proceeding on the basis of the learning network theory, the issue can be rephrased as follows:

- how is the work network organized and which developments are taking place in it;
- how is the learning network organized and which developments are taking place in it;
- to what extent do the (changes in the) work network and the (changes in the) learning network correspond?

Research questions. For this research project, concentrating on a limited number of elements of the work and learning networks, we formulated the following research questions:
1. Work: what are the tasks and responsibilities of the careers advisers and in what respect are they changing? The analysis here was conducted on the basis of the four types of work outlined in Figure 4.

Figure 4: Four Types of Work

	TYPE OF WORK			
	individual work	task work	group work	professional work
TASKS AND RESPONSI-BILITIES	broad range	narrow and simple	varying	complex
	individual autonomy (contractual)	centrally determined (standardized)	collectively determined	externally determined

This figure serves to locate the work, i.e. the jobs of the Dos careers advisers, along one or several dimensions and indicate the direction in which the changes are taking place (compare Figure 3). 2. The learning network: what is the structure (in terms of both content and organization) of the learning network and what changes are taking place in it? The analysis here involved the structural characteristics of learning networks as outlined in Figure 5.

Figure 5: Content and Organization Structure of Four Types of Learning Networks

	LEARNING NETWORKS			
	liberal loosely coupled	vertical mechanic	horizontal organic	external innovative
CONTENT STRUCTURE	• unstructured	• structured, programs	• open, problem-oriented programs	• knowledge and method-based programs
instruction	• loose aggregate of learning situations	• instruction on the job and training • job-centered	• on-the-job learning • group learning	• external and training courses • on-the-job learning/ supervision
ORGANIZATION-STRUCTURE AND ACTORS	• individual responsibility	• 'learning' specialists	• group members	• professional
	• enterpreneurial, contractual relationships	• formalized relationships (teacher - student)	• organic relationships	• professional relationships
	• via individual contacts	• internal and external specialists	• internal and external consultants	• external

Here, too, the figure should enable us to situate the learning network at Dos on one or several of the dimensions.

3. The correspondence between the work and learning networks. In the learning network theory, a certain degree of correspondence is expected to exist between the work network and the learning network. The question then becomes whether this holds true for the (changes in the) job packages of the Dos careers advisers and the structure of the learning network at Dos.

Research design: a diagnostic case study and secondary analysis. Research was conducted in one organization, Dos, and can be typified as a combination of (a) a 'diagnostic case study' and (b) a secondary analysis (Miles & Huberman, 1984; Brooks & Watkins, 1994).

(a) The diagnostic case study. The information about the work and learning networks at Dos was collected using the following methods:

* analysis of documents, including annual reports and internal discussion papers;
* formal interviews with the director, two team leaders and (six) careers advisers using topics lists based on the learning network theory;
* informal conversations about the daily goings-on at Dos as well as about the analyses (with one of the team leaders);
* group discussions in the management team and in the careers advisers' staff meeting, about the analyses made by the researchers. Some of the respondents also commented on the analyses in writing;

This information was recorded in extensive reports which were then analysed on the basis of the different elements of the learning network theory. The aim of this analysis was to typify the work and learning networks, that is to say, to situate the two networks in the three-dimensional space. The results of these analyses were then discussed in the management and staff meetings.

(b) The secondary analysis. The roughly structured data and analysis results were used to answer the specific research questions pertaining to the careers advisers' job packages and the structure of the learning network.

Results

Dos is a simple organization. The emphasis is on work operation. There is a management team consisting of the director and two team managers. The core members of the teams, each consisting of about ten employees, are the careers advisers, who can delegate part of the work, testing, to test assistants. Both the learning network and the work of the careers advisers at Dos are only weakly structured.

The work at Dos. The work performed at Dos is undergoing a transition and displays characteristics of both professional and individual craft labor. Essentially, the careers advisers' jobs comprised individual careers and education counselling research. An additional task was to provide information on employment and education opportunities. They worked individually, on the basis of the procedures they had learned during their initial training.

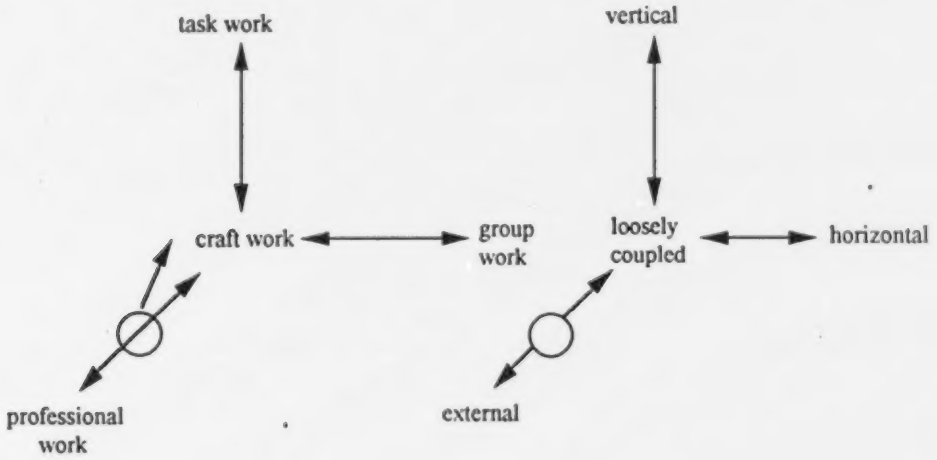
The careers advisers' responsibilities have been broadened up considerably lately, and in two regards: a broadening-up of client problems and a broadening-up of the tasks package. Apart from individual research and counselling, they are now required to conduct individual and group training programs. Counselling is also required to be more finely attuned to the specific problems of the clients. Careers advisers are less able to fall back on tried-and-tested standard procedures, but have to work together with the client to analyse his or her specific questions and develop a suitable program to answer them.

An important new addition to the job package is public relations and marketing. In the past, the director and team leaders took care of PR and marketing. But for some time now the careers advisers are also required to bring in new commissions and maintain good relationships with their clients.

The learning network. The Dos learning network is meager and hardly structured in any explicit way. For the careers advisers, learning is a predominantly individual, incidental and informal matter. Apart from these individual advisers, who learn as they work, only few actors are active in the learning network at Dos and no specific learning network tasks have been given

to any of the staff members. There are virtually no explicit links with external actors in the field of training and learning. 'Learning matters' are raised only incidentally, for instance when careers advisers ask their team leaders permission to attend a conference, or during supervision sessions.
In principle, the work itself offers many learning opportunities, but refresher and postgraduate courses are limited to the occasional external course or congress. In recent years, no changes have taken place in the content or organization of the learning network: basically, the initial vocational training is still the learning network.

Figure 6: changes in the work and learning network of Dos (○)



Work and learning network. The work is moving from professional work, with relatively narrow but complex functions dertermined primarily by the professional associations in the environment of the Dos organization, in the direction of individual craft work.
In the past, the learning network consisted mainly in formal, initial vocational training. This training constitutes the core of an external innovative learning network. The accompanying postgraduate and refresher courses never came off the ground in any significant way. At the time there was no need for such courses, since the work itself did not change much either, so the learning network remained virtually unchanged. However, this limited learning network is no longer equipped to support the careers advisers in coping with the changes going on in their work.

Implications for HRD

Making a thorough diagnosis of the work and learning networks is a prerequisite for sound and effective consultancy on the part of HRD officers. The development of a sound diagnosis and of an improvement program based on it is a process between the actors in the learning network, however, in which the HRD advisor can also play a role. HRD advisors should be well informed about the (existing situation and development tendencies in the) learning network if they are to be able to determine their own place in it and gear the content and direction of their interventions to those of the other actors.

Combination of global and specific diagnosis. In our view, the diagnosis can best be carried out as a combination of a global and a specific diagnosis. The first requirement would be

to sketch an overall picture of the work and the learning network, both situated in the three-dimensional space. Going deeper, a specific diagnosis could be made of some elements of the work and the learning network. In the case of Dos, such a specific diagnosis was made of the job content and the structure of the learning network, but specific groups of actors could also be singled out for further analysis, such as the actions or views of external actors or of the careers advisers. It is essential that the specific diagnosis should remain substantially connected with the global diagnosis; the interpretation of the results rests on the location of the network in the three-dimensional space.

Improvement of learning networks, three basic principles. Three basic principles should be observed in initiatives to improve learning networks:

a. We perceive of improvement as a process of development that can take different directions. The existing learning network is located somewhere in the three-dimensional space and can be pulled in different directions from there. In the case of Dos, for instance, alternatives to an improvement of the existing external learning network could include developments in a liberal, a horizontal as well as a vertical direction. In an organization with a vertical learning network a development towards horizontalization could be an option.
b. Improvement of the learning network should be accompanied by an improvement of the work. In the case of Dos, the work is evolving from professional labor in the direction of individual craft labor. The external dimension therefore requires a great deal of attention in the development of the learning network.
c. Improvement should link up with the existing initiatives and plans of actors. Both within and around organizations there are always actors who are already thinking about how to improve the learning network. Such initiatives may not always be very well thought out or systematic, they are fine starting-points for further systematic action. A specific diagnosis is an excellent opportunity for detecting such initiatives.

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Employee Efficacy Generalization of Basic Mathematics Skills

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The purpose of this study was to evaluate the level of generalized self-efficacy perceptions for basic mathematics development to other, less directly related, applications. These applications included daily personal and work related activities which require mathematics attention. The study proposed that the noted gains in performance were, in part, due to improved perceptions of self-efficacy related to basic mathematics and its subsequent generalization to activities which impact the work place. The research applied a quasi-experimental design, utilizing a pre- and posttest of self-efficacy perceptions. The results suggest that as individuals are given the opportunity to participate in developing their basic math skills, perceptions of ability increase for skills associated with personal daily activities, and ultimately with work activities requiring math attention.

Adult literacy is one of many factors that contribute to the quality of work-life and overall work performance, but as technology advances and the necessity of complex work skills increases, it becomes an increasingly important element for success in the workplace. Raising an individual's basic skill level to one representing an appropriate degree of literacy affects the individual in a host of ways. There are obvious benefits, such as a broader vocabulary and greater math comprehension which may, in turn, enhance communication and problem solving abilities. There may be, however, potential benefits beyond these which exist. The enhancement of less tangible attributes such as pride and self confidence may also be affected.

How are these tangible and non-tangible qualities manifested within an organization? One Motorola manufacturing facility reported a 33% reduction in absenteeism, a 4.2% reduction in scrap, an 18% reduction in cycle time, an 18% improvement in production based on outs and a 42% improvement in production based on turns after the organization contracted for and implemented a "workplace literacy program" (Merex, 1993).

Motorola clearly acknowledges some type of transformation other than simply improvement in basic skills test scores. They identified "self-esteem" as one attribute which was "elevated" (Merex, 1993). This study investigates a possible link between the development of an individual's basic skills and the improvement of organizational performance. The cause of the positive change appears to be the basic skills training which ultimately has the effect of improved performance. The question remains, "How would a seemingly unrelated event such as basic skills development manifest itself in performance enhancement? What mediating variable contributes to this shift?" The following thesis evaluates how developing basic skills effects a person's perceived self-efficacy and ultimately how this 'shift' in self efficacy transfers to performance.

Bandura (1977) described an efficacy expectation as, "the conviction that one can successfully execute the behavior required to produce the outcomes" (p. 79). There are many elements that may affect efficacy levels; experiences, training, support, and environment, to name a few. This study looks at the impact basic math training has upon one's perception for basic math efficacy and how one's efficacy is subsequently generalized.

Self-efficacy is generally associated with Albert Bandura (Betz & Hackett, 1983; Campbell & Hackett, 1986; Cooper & Robinson, 1991; Gauthier & Ladouceur, 1981; Lee, 1983; Lent, Lopez, & Bieschke, 1991; Manning & Wright, 1983; and Pajares & Miller, 1994). A unique quality of perceived self-efficacy is that it can be changed; either diminished or expanded. Bandura (1982) states, "In the social learning view, judgments of self-efficacy, whether accurate or faulty, are based on four principal sources of information. These include performance attainments; vicarious experiences of observing the performances of others; verbal persuasion and allied types

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of social influences that one possesses certain capabilities; and physiological states from which people partly judge their capability, strength, and vulnerability" (p. 126). Each of these four "modes of influence" represent very different sources of efficacy determinants.

The first time we touch something hot, we learn not to touch it again. We also learn not to touch other items which are "hot". This enactive learning experience, although painful, is extremely efficient. Learning by doing is recognized almost intuitively as an efficient manner with which to teach many things, but the question remains, how does enactive learning compare to other attainment means? When proficiency of a behavior is considered, there is strong support for the position that enactive, or performance, attainment is the most influential medium of efficacy impact (Bandura, Adams, & Beyer, 1977; Feltz, Landers, & Raeder, 1979). Feltz, et al., (1979) compared the performance and measure of self-efficacy for divers who were led through actual diving experiences with those who learned through observation (either live or videotaped) and found the former group fared much better than the latter two groups. According to Feltz, et al., (1979): "As predicted, the participant-modeling treatment produced higher, more generalized, and stronger efficacy expectations than did modeling-alone treatment which was based upon vicarious experience" (p. 118). Vicarious learning, however, is not without merit. The modeling-alone divers in the study reached some level of performance and demonstrated some standing of efficacy expectation indicating that learning can take place through observation. If learning was dependent totally upon actual experience, there would not be enough time available to actually enact every behavior we need in order to merely survive.

Persuasion by others represents a less effective, but, none-the-less, a real source of efficacy influence (Bandura, 1977). This source of feedback is subject to the circumstances surrounding the behavior. For example, if one is persuaded by a friend that she/he can perform an action and she/he is given the necessary support to successfully effect the action, her/his perception of success will likely be enhanced. Conversely, if the individual is persuaded that he/she can perform an action, but given insufficient support, her/his perception of success will likely be diminished. Regardless, the strength of efficacy perception obtained through persuasion is likely to be much more vulnerable to setbacks than perception obtained through actual successes. (Bandura, 1977, 1982, 1986).

Additionally, our feelings evoke conclusions about our ability to perform. Fear, stress, and other strong emotions can be barriers to action, or at times may create a sense of ability beyond that which an individual normally possesses. Bandura (1977) states, "Because high arousal usually debilitates performance, individuals are more likely to expect success when they are not beset by aversive arousal than if they are tense and viscerally agitated" (p. 198).

Bandura (1977) recognizes magnitude, generality, and strength as dimensions which have an important impact upon efficacy expectations. These dimensions of expectations must be considered as they play an integral role in the understanding of efficacy. It is the dimension of **generality** which was the theoretical construct for this study.

One may feel accomplished at a specific task, but when faced with a like task at a much higher level of difficulty, that individual may feel inadequate to deal with the trial. For instance, in high jumping, a particular jumper may be very confident that she/he is able to jump four feet, but when faced with a height of 4 foot, six inches, the level of expectation is diminished. This can be examined in terms of individual levels of perceived self-efficacy. The individual may have a relatively high perception of efficacy that is demonstrated in confidently completing any jump of four feet; add six inches to that target and the expectation is sorely challenged (Bandura, 1986). This impact to one's perception of self efficacy falls into the self-efficacy dimension of magnitude.

Secondly, self-efficacy can be examined by the dimension of strength. Consider the expression, "It's like riding a bicycle; once you learn you never forget." Self-efficacy strength is much like this. Perceiving many of our skills as mastered, we are confident each time we execute them; with little regard to occasional failures and/or time. It would be difficult to diminish our confidence in ourselves to perform these tasks. Bandura (1977), characterizes the dimension of strength as, "Weak expectations are easily extinguishable by disconfirming experiences, whereas individuals who possess strong expectations of mastery will persevere in their coping efforts despite disconfirming experiences" (p. 194).

The final dimension of self-efficacy, *generality*, can be understood by considering two different young students. One student achieves a level of accomplishment in a math quiz, which confers her/him a higher level of expectation to do well on future math quizzes. A direct benefit of this new found confidence (possibly because of new and improved study habits) may be experiencing a higher level of confidence to perform well in other areas of study. On the other hand, the second student, achieving the same level of success may not necessarily generalize that other areas of study will improve, but is confident that in future math quizzes, if she/he studies, she/he will continue to be successful. Each of us generalize our successes differently, thus altering our sense of self-efficacy experiences accordingly (Bandura, 1977). As stated earlier, this study purports that our ability to generalize self-efficacy expectancies is useful in understanding how seemingly unrelated behaviors are associated.

Generalization of Self-efficacy

The relationship between mathematics development and self-efficacy has been well documented (Betz & Hackett, 1983; Hackett, 1985; Cooper & Robinson, 1991; Lent, Lopez, & Bieschke, 1991; Matsui, Matsui, & Ohnishi, 1990; Pajares & Miller, 1994). Although much research in the area of basic skills (Bandura & Schunk, 1981; Pajares & Johnson, 1993; Schunk, 1981, 1982, 1983; Schunk & Rice, 1991, Schunk & Swartz, 1993) supports the view that a strong relationship exists between performance and self-efficacy perceptions, there is limited literature which either supports or questions the generalization dimension of self-efficacy (Brody, Hatfield, and Spalding, 1988).

Generally, the subject of generalization was addressed as an after thought. As stated, the generalization of self-efficacy is the tendency for one to generalize those acquired behaviors which we have mastered to other behaviors. The inclination is to generalize to like behaviors (Bandura, 1977; Biran & Wilson, 1981; Brody, et al., 1988). Additionally, learnings which have impacted our self-efficacy expectations due to performance accomplishments are more likely to be stronger and more generalized (Bandura, 1977 & 1986; Bandura, Adams, & Beyer, 1977; Biran & Wilson, 1981). Generalization of self-efficacy also appears to increase as command of skills increases (Bandura, 1986). Encouragement has proven to be a factor in the generalization of self-efficacy, particularly with regard to treatment of phobias (Bandura, 1986).

Biran and Wilson (1981) looked at the generality exhibited by phobics undergoing a variety of treatments. It was questioned whether one who appears to reduce anxiety associated with a fear of one kind and has that fear extinguished or partially extinguished, would transfer that learning to a similar fear. Those individuals who participated in the performance accomplishment condition (guided exposure), "reported major changes in their daily life, to the point where their phobias ceased to constitute a problem" (p. 987). Biran and Wilson found generalization to take place and to be strongest for performance attained self-efficacy (p. 898). Williams (1992), adds, "when agoraphobics are given performance-based treatment for one of their phobias (e.g., driving), while another phobia (e.g., grocery shopping) is left untreated, generalized improvement occurring in the untreated phobia is accurately predicted by degree of improvement in self-efficacy for that phobia" (p. 157). The generalization of self-efficacy was again supported in research conducted by Brody, Hatfield, and Spalding (1988). In an evaluation of the generalization of a high-risk task (rappelling), Brody et al. (1988) determined that self-efficacy was generalized for "similar situations" (p. 32).

Research Questions and Hypotheses

The primary purpose of this study was to evaluate the level of transfer of self-efficacy perceptions for basic math development to other, less directly related, applications. These applications included daily activities and work impact. This effort explored one possible explanation for increased organizational performance after members experienced enhancement of their basic skills. Specifically the question this study posed was, *Is it possible that individuals tend to generalize*

from the development of her/his level of perceived self-efficacy for basic skills to her/his perception of self-efficacy for work impact?

The formal hypotheses for this study were:

1) Upon completion of basic math development, participants will demonstrate a level of perceived self-efficacy for math, which reflects any improvement or digression in performance.

2) Participants will demonstrate a level of perceived self-efficacy related to daily personal activities which require mathematics attention, in relation to any change to perceived self-efficacy for math.

3) Participants will demonstrate a level of perceived self-efficacy related to work activities which require mathematics attention, in relation to the results to any change in perceived self-efficacy for math, but to a lesser degree than a change noted for perceived self-efficacy related to daily personal activities which require mathematics attention.

Method

Participants The participants were adult men and women employed by a company associated with the health care industry. All participants worked in a manufacturing environment as production workers, or support staff. All members of the group which received training in basic mathematics willingly enrolled in the training course and voluntarily participated in the study. Members from the control group were not currently enrolled in the mathematics course, or a math-related course. Their participation in the study was also voluntary.

Design of Study This study was a quasi-experimental design conducted in an action research environment. The data gathering plus the training in basic math took place in a field setting. Two groups were used in this study. The treatment group, or Group One, consisted of participants who were enrolled in the basic math course. Two instructors taught the course; one taught two sections and the other taught one section. The subject matter was identical. Group Two consisted of participants who were not enrolled in the math training course, or any other formal math related course, during the span of the evaluation. The group served as a control group. A minimum of thirty participants was maintained for both groups; Group One had thirty two members and Group Two, forty eight.

The mathematics course was conducted by a local two year community college in partnership with the organization which employed the participants. The course was an introductory level math course identical to those offered by the college on campus. The students received no compensation for participation in the classes, but the classes were provided at the work sight.

Both groups were given a pre- and posttest which measured self-efficacy perceptions for basic mathematics. The test also included sections which measured the tendency for one to generalize from a specific behavior, to a broader behavior. In this case, the measure evaluated the tendency to generalize one's perception of her/his ability to solve basic math related problems, to daily tasks which are math related and ultimately to work tasks, which are math related. Additionally, the members of Group One were given a pre- and posttest of basic math skills.

The dependent variable for both groups was self-efficacy with the addition of mathematics performance as a dependent variable for Group One. The independent, or treatment, variable was the basic mathematics training which Group One received. Furthermore, the measurement tool included an exploratory section intended to measure the tendency for the dependent variable of self-efficacy to be generalized by both groups. Thus, the generalization of self-efficacy, is also considered a dependent variable.

Instruments A mathematics self-efficacy scale was developed, piloted (revised), and tested for reliability and validity. The scale was constructed using Likert principles and consisted of four subscales related to self-efficacy and generalization of math skills; self-efficacy for

mathematics, self-efficacy for personal math-related activities; self-efficacy for work-related activities, and self-efficacy for generalization of math skills. A standard pre- posttest for the mathematics course was also utilized which measured acquisition of basic mathematics skills.

Data Analysis Each of the measurement sections for self-efficacy was evaluated separately. No single total figure was used to compare performance. T-Tests for paired samples were calculated between pre- and posttest scores for comparison between the two indices. Additionally, pre- and posttest scores for the generalization sections were evaluated and compared in order to determine if change was statistically significant. For Group One a comparison between mathematics self-efficacy and math performance was made.

Results and Conclusions

The hypotheses in this research predicted a change in one's perceived self-efficacy with regard to math related activities as one undergoes training in basic math. To test the hypotheses, data were analyzed using a t-Test for paired samples. Because of the repeated measures (pre- and posttesting), a correlated sampling design was used (Spatz & Johnston, 1989). During the analysis of the instrument, a descriptive form of statistical analysis as well as a mathematical item coefficient comparison was utilized. The analysis also addressed reliability and validity.

The analysis first addressed the results from the development of basic math skill for Group One. Hypothesis one was evaluated using the data from the t-Test analysis of the math self-efficacy testing. These data were compared to math proficiency improvement. The second hypothesis was evaluated using figures from pre- and posttests for self-efficacy perceptions for math related to personal activities. A comparison of t-Test values was made between these results and those for math self-efficacy. Hypothesis three was assessed by analyzing self-efficacy perceptions for work related math activities in comparison to those for perceptions for personal math related activities. A similar analysis was performed for Group Two, but with additional emphasis upon the question of reliability for the instrument developed and used in this study.

The t-Test for paired sampling compares pre- and post scores for a target group. In this study two groups were utilized. The test establishes a boundary ("t Critical" measurement) which is based upon the degrees of freedom. The degrees of freedom (df) may be determined by the sample size minus 1. As with other calculations, a N = 30 is advised, but for t-Tests, not required. In this study both group sample sizes exceeded 30 (group 1 = 32 & group 2 = 48). The t Critical measurement provides the boundary for which the decision to either reject, or accept the null hypothesis (Ho) may be made. If the absolute value of the calculated t score, referred to as "t Stat", is greater than the t Critical measurement, the null hypothesis is rejected; if not, the null hypothesis is retained. The null hypothesis states that the two populations have the same mean. Because the formal hypotheses predict change within the treatment group, the null hypothesis must be rejected in order for these to be supported. All calculations which are discussed have been made with a confidence level of 0.95 (= 0.05).

Group One There was a highly significant statistical difference between pre- and posttest scores for math skill. The absolute value of t Stat (11.780) is substantially greater than the value of t Critical for one-tail analysis (1.696). All participants with the exception of one showed improvement with regard to math performance scores. The individual who did not show improvement scored the maximum on both the pre- and posttests. The only other individual who did not show double digit gains, scored high enough on the pre-test so that only nine points could be gained with a perfect score on the posttest.

It is clear that the variance in the means for the math performance scores is significant and thus supports the rejection of the null hypothesis. The question posited is, "How does this impressive improvement for basic math performance translate into one's perception for self-efficacy associated with math?" Although it was anticipated that Group One participants would experience gains in performance, it was not hypothesized. The impact that the math development subsequently has, of course, was hypothesized. Hypothesis one states: Upon completion of basic mathematics development, participants will demonstrate a level of perceived self-efficacy for mathematics which reflects either improvement or digression in performance.

The results achieved from math development indicate that self-efficacy perceptions for math would also improve and this was the case. Group One math self-efficacy showed a statistically significant increase; t Stat = 2.519 vs. 1.696 for t Critical. The significance is less than the value achieved for math performance, but still significant. The null hypothesis for Group One math self-efficacy is, therefore rejected, and hypothesis one supported. These results are not unexpected as research has demonstrated that math self-efficacy is influenced by a variety of treatments (Bandura & Schunk, 1981; and Campbell & Hackett, 1986). The results are important in establishing a construct relation, which is critical for construct validation.

The second hypothesis states, "participants will demonstrate a level of perceived self-efficacy related to daily activities which require mathematics attention, in relation to a change in perceived self-efficacy for mathematics." The importance of this hypothesis is that it predicts the generalization of one's self-efficacy from basic mathematics to personal activities associated with mathematics. Here the results also support the rejection of the null hypothesis and the acceptance of hypothesis two. Interestingly, the significance achieved was higher than that for mathematics self-efficacy. The t Stat was equal to 3.997 and t Critical of course remained equal to 1.696.

The third and final hypothesis asserted that generalization of self-efficacy for math would continue to be generalized into an individual's perceptions with regard to math attention at work. It was hypothesized that the level of significance would be less than that generalized for personal math activities such as balancing one's checkbook. The results supported the rejection of the null and the acceptance of hypothesis three. As predicted, the significance (t Stat = 2.179 vs. t Critical = 1.696) was somewhat less than that seen for self-efficacy related to personal math activities.

Group One's tendency was to translate improved math skill into higher self-efficacy perceptions related to math. Furthermore, the results also support the belief that one tends to generalize one's perception of self-efficacy. While Group One showed a quantitative shift regarding the measurement indices, the results remain unconvincing without a review of Group Two.

Group Two The control group received no basic math development (treatment) during the period of the study. Any extraneous or chance variable which may have influenced the results was generally available to members of both Group One and Group Two. Any influence was anticipated to be random in nature.

Group Two served as both a check and balance for the results obtained in Group One, and as a test for reliability of the instrument. This portion of the analysis addressed the results with regard to the statistical significance and what this means when compared to Group One. As stated, the control group was not given pre-and posttests for math performance. In order for the formal hypotheses to be endorsed and ultimately for test reliability to be established, the results for Group Two must fail to reject the null hypothesis.

-Group Two results for math self-efficacy failed to reject the null hypothesis. Because of the difference in size for the two groups, t Critical for Group Two was equal to 1.678. The t Stat results for Group Two mathematics self-efficacy was equal to 1.425. In both groups the results for math self-efficacy, although supportive of predicted results, were not as substantial as might have been expected.

The data for self-efficacy perceptions which apply to personal math related items indicated little variance for Group Two. The t Stat equaled 0.894 and when compared to the t Critical value of 1.678 indicated no significance.

These results fail to reject the null hypothesis and thus strengthen the argument that Group One experienced a shift in mathematics efficacy related to personal activities. The case for generalization is also strengthened. Additionally, reliability of the instrument is supported.

The data summary for Group Two's response to the portion of the instrument which addressed self-efficacy related to math in the work place again failed to reject the null hypothesis, indicating that, as expected, the treatment did impact Group One's perception of self-efficacy with regard to work related math items. Also, the instrument provides a reasonable degree of reliability. The t Stat was equal to 0.7912 which, when compared to the t Critical of 1.678, indicates the means are from the same population.

The overall results for Group Two maintain the acceptance of the formal hypotheses by failing to reject the null hypothesis for all three sections discussed. The data from Group Two also

strongly support the acknowledgment of format reliability for these portions of the instrument. Prior to looking at instrument reliability and validity, the portion of the instrument which addressed the tendency to generalize was evaluated. This portion was not formally a part of the hypotheses, but rather, was utilized as an exploratory tool. The items, as stated, were a divergence from the format used to assess self-efficacy perceptions. The items asked for responses to perceptions of, if this, then this.

Generalization The data produced in the generalization section of the instrument were purposely excluded from formal hypothesis. It was anticipated that these data would offer insight into the outcomes previously discussed. As with the data for self-efficacy perceptions, Group One data indicated a significant shift, while Group Two did not.

The t Stat (3.060) for Group One indicates that the mean has a high degree of possibility of falling outside the limit established by the t Critical figure (1.696). The t Stat (0.668) for Group Two, however, indicates that it is unlikely the mean lies outside the t Critical range of 1.678. All indications are that the members of Group One showed a measurable difference in their perceptions with regard to the generalization of math skill. Two questions remain, "Was this portion of this test reliable and did either group show an initial higher propensity for generalization?" Both questions may be answered by looking at and comparing pre-tests. Table 1 represents a summary of a t-Test for a difference in two population means, when the standard deviation is unknown and the means are assumed equal.

Table 1. t-Test: Two-Sample Assuming Equal Variances; Group 1 and Group 2, Pre-test

	Group 1	Group 2
Mean	*29.375*	*30.10204*
Observations	*32*	*49*
Hypothesized Mean Difference	*0*	
t Stat	*-0.561932*	
t Critical one-tail	*1.664371*	
t Critical two-tail	*1.990452*	

It is reasonable to assume that both groups entered into the study with a relatively similar propensity toward generalization. Although the study is quasi-experimental in nature, both groups come from the same population. The t Stat figure in supported the retention of the null hypothesis supporting the assumption that both groups began the study with a similar propensity to generalize (again assuming that the generalization portion is a valid measurement of this concept). Regardless, both groups appear to have started equally positioned. Coupled with the relationship between pre- and post testing for Group Two, it can be argued that regardless of what the section measures, it was reliable. When the results for sections two and three for both groups are considered, it is reasonable to speculate that the generalization section adds support for construct validity. This section was intentionally worded in a manner which required the respondents to relate one behavior to that of another. For example, one item states, "Learning math helps my reading skills." All other sections asked for rating of a specific action. For example, "I have difficulty dividing numbers."

Significance to HRD

The problem statement was developed to determine the fundamental relationship between literacy enhancement and organizational improvement. The concept of self-efficacy was posited as a potential link. As the results support this position, it is recommended that further clarification of the role self-efficacy plays within an organization be explored. The recommendation is that the concept of self-efficacy be explored and looked at more critically as a possible tool for

organizational use. Subjectively, one knows that a person who has a strong perception of her/his abilities will generally outperform an individual who generally feels poorly about her/his ability to perform. In the past, this gap has generated such labels as, "lazy, poor attitude, bad influence, etc." for those who may merely hold poor perceptions of their capability. Organization leaders must begin to recognize what type of strategies for development are available and take advantage of these. One such strategy is the enhancement of self-efficacy. As demonstrated in this study, an event as straight-forward as the development of an individual's basic math skill, has a broader, more comprehensive impact, both for the individual and for the organization.

Ultimately an organization's success depends upon the contribution of its members. The level of skill which is required and how this coincides with the level that the organization's members possess is critical. Generally speaking, adult literacy requirements will continue to be a crucial element in the ultimate success of any organization (Newman & Beverstock, 1990). It is recommended that the importance of adult workplace literacy be recognized as a key element in the ultimate success, or failure, of most organizations.

Although many questions remain, the results provide interesting insight into the perceptions one has regarding her/his ability to "execute a behavior." With the understanding that generalization of this perception does occur, organizational professionals, trainers, educators, and ultimately learners may be better prepared for augmenting the learning process. More specific research is called for; research which may enhance the understanding of how specific teach strategies, or methods, impact the learner's self-perception of ability.

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A Case Study of the Feasibility of Developing a Writing Test for Hiring Technical Writers and Instructional Designers.

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This paper describes the process used to develop a writing test for technical writers in a high technology company. The test used accepted linguistic principles used to evaluate the degree to which instructions and consumer documents conform to plain language standards. Although the test did yield high interrater reliability, such tests are inevitably subjective and can not be assumed to have validity equal to accepted standardized measures.

The Purpose of the Study

This case study describes the development of a writing test to be used in hiring technical writers and instructional designers at a high technology company. The test development was one facet of an ongoing four year workforce literacy project. The management recognized the need for developing a skilled workforce and undertook a broad workforce literacy program (Park, 1996). A set of hiring standards was developed for the assembly workers and the non-management personnel. Although the hiring policy has been effective, the results of a literacy evaluation of the documents used on a daily basis by the workers showed most were written at a level that was unnecessarily high. A workshop was given for the engineers and trainers who wrote the documents. The company also decided to hire technical writers and instructional designers who would work full-time on writing workplace instructions and training materials. In order to ensure the people who were hired could indeed write, the company decided to prescreen those that applied for the job. Consequently we set about designing a writing test based on well researched principles of plain language and document design (See Redish 1979) to be used in hiring technical writers and instructional designers.

The development of this test took place at a time when the entire training HRD philosophy of the company was undergoing a change from behaviorist to cognitive approaches in training. The job descriptions called for applicants who had a conceptual understanding of the job processes and training each work category required. It was also very important that they could communicate effectively in writing and produce documents and training materials that were well organized. The writing test was designed to assess the skills of the technical writers and instructional designers according to these criteria.

Research into Writing

Writing workplace documents bares little resemblance to writing the type of narrative text taught in a typical creative writing class. Workplace documents are typically one or two pages in length and are predominantly reading-to-do rather than reading-to-learn in intent (Mikulecky et al 1980). The user relies on workplace documents either as a reference to act as a guide or instructions in the production process or manuals are used as external memory references only when things go wrong (Mikulcky et al, 1994). Extensive and somewhat dated research has been undertaken in the areas of comprehensibility and useability of workplace documents by Redish. et al at the American Institutes for Research (Redish, 1979). Much of this research identifies those features that make documents difficult to understand (comprehensibility) or to extract information from (usability). These features based on extensive linguistic research are incorporated into sets of guidelines for "plain language" that have been adopted by numerous states as a guide to writing legal contracts intended for the general public (Park and Harvey, 1985). Although the guidelines for plain language have had extensive use in legal and bureaucratic fields, the industrial use of such guidelines has been almost non-existent. Workers in manufacturing for example, are frequently asked to read process sheets, or inspection sheets that would tax the skills of a college graduate (Park, 1996).

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In this context, hiring a technical writer who can produce training and operational documents that conform to plain language criteria is crucial. They must be able to produce documents that are below an eighth grade level and thus comprehensible to the average worker (Functional literacy in the United States is assumed to be eighth grade and up to 30% of workers read below this level, Carnevale et al 1990). In addition they must be able to produce instructions and training materials that are easy to use. Is the writer able to organize the material? Can the writer analyze complex tasks into sub-tasks? Can they keep directions simple? Can the writer sequence information in a logical way so that it follows the operation step by step. Procedural instructions must be presented on the order they are to be performed. Can the writer keep language simple and separate out need to know from nice-to-know? The writer must write clearly and concisely?

Organization is the most important element. However language and style are also extremely important. The vocabulary must be simple and straight forward The syntax must not be too complex. For example, sentences should be kept short -- the guidelines suggest an average of twenty-two words or less. In addition, paragraphs should be less than 60 words. (See Sticht, 1975). The ideas in each sentence must also be kept in a logical order.

Finally the mechanical elements of writing traditionally identified with good writing, although not always crucial to the communication of meaning, must be respected. Spelling must be accurate. Similarly there should not be errors in grammar and usage -- the punctuation should be correct.

Questions to be Addressed.

Can a writing test for industrial writers be developed that conforms to psychometric standards of validity, reliability and generalizability?

Can this test also be developed in a way that is cost effective to use, can be easily used by HRD personnel, and is accepted by applicants as a fair test?

Methodology

Test development

A pilot version of the writing test was developed by a plain language expert and the director of training for the company. The test used all of the criteria established for the development and assessment of plain language adopted by states across the country to identify plain language in the legal and technical fields (Park and Harvey, 1985) These criteria are well researched in a variety of fields (Charrow 1981). The scoring protocol divided the plain language criteria into sections based on organization, language and style, and format.

Table 1: Criteria for evaluating writing samples.

1. Organization

a. Is the writer able to organize the material?

For example: Can the writer analyze complex tasks into sub-tasks?
Keep directions simple?

Can the writer sequence information
Procedural instructions must be presented on the order they are to be performed.

b. Conciseness

Can the writer write clearly and concisely?

For example: Irrelevant nice-to-know information should not be interspersed with need-to-know information.

2. Language and style

Vocabulary is simple and straight forward.

Syntax not complex

For example: Sentences short (Average 22 words or less)
Paragraphs (should be less than 60 words)

Ideas in each sentence are in a logical order

Spelling is accurate

Grammar and usage correct

Punctuation correct.

3. Format

Does each direction start on a new line?

The test required the applicant to write a set of directions for two tasks from a list of six common daily tasks that all applicants would be familiar with. These included tasks such as filling a car's gas tank or getting cash from an automated teller machine (ATM). The EEOC guidelines prohibit hiring tests which are based on material the applicants could only acquire by either working in the company or training with the company for the job (Park, Dawis et al 1986). Consequently we tried to select tasks that would not favor any one group.

Fifteen volunteers in jobs most similar to the jobs the test was to be developed for were asked to take the writing test. Each candidate's writing sample was rated according to the "plain language" criteria in Table 1 above by three independent raters all Ph.Ds or Ph.D. candidates in Adult Education and HRD.

The raters made notes on how they had scored the tests and the relative ease with which each criteria was applied. It soon became apparent that some of the plain language criteria were not relevant to writing sets of instructions. The test simplified and revised to include only three major sets of criteria that were most reliable and had most usefulness in judging the way instructions are written. A set of instructions provide a much more limited sample of writing behavior than traditional continuous prose.

The revised test was then given to fifteen additional volunteers and a final version was developed. This version was then used on two consecutive groups of 15 and 11 applicants, these were independently scored. We compared the interrater reliability of the scoring system and ran correlations on each set of scores using the EXCEL program for Macintosh.

The performance of the candidates on the test and subsequent job performance appraisals are being collected to establish concurrent validity for the test.

Results

This case study is intended as a guide that will enable HRD specialists to develop a content valid and reliable test of writing skills that their companies can use to ensure that those hired to write industrial process sheets, inspection sheets, safety information and warnings as well as more sophisticated training materials will have the skills they need.

Judging writing skills and assigning a score to each plain language category proved to be difficult. The final scoring categories were developed after the initial trial of the test are given below. All three raters agreed that the following were easy to apply.

Criteria	Organization (50 points) All steps in the correct order and present	Language & style (30 points)	Jargon (minus 10 points)	Spelling (minus 1 per instance)	Grammar (-30)	Total score

Interrater reliability on the first set of writing samples was r=.6. After a discussion of the criteria used for scoring and a more detailed set of instructions was added the correlations obtained were .74. If the top three and lowest three scorers were considered separately the correlation is .81.

Based on these criteria we are confidant that we identified the best writers and these are clearly distinguishable from the rest. Our top scorers wrote well. The instructions to the applicants were clear and easily followed. The instructions to the scorers easy to use.

However, whereas the top writers and the lowest were easily distinguished, the same could not be said for those who scored in the middle range. The interrater reliability tells us that the level of variability would be unacceptable if the writing test were the only criteria used in hiring. Rather it identified those applicants who were qualified to handle the writing responsibilities required of them. It also disqualified those with poor writing skill.

Ultimately, the concurrent validity offered on on-going success on the job and good performance appraisals are needed before this test can be used by other companies. One way of improving interrater reliability is by developing stricter more detailed scoring criteria that are explained clearly and give less leeway to scorers.

The test we developed was relatively cost effective and proved to be easy to use. Initial reaction by the applicants was favorable. Once applicants were given information on how the writing was to be judged and who was doing the judging, initial fear levels were lowered. There was some unhappiness on the part of long time workers who had hoped for promotion within the company but who could not write at an acceptable level. Commonly in HR, trainers are hired from the shop floor. Although excellent workers, they have no concept of how to write instructional material. Increasingly effective communication skills orally and in writing are vital to manufacturing efficiency especially in team organizations.

Importance and Interest to HRD Professionals

More and more employers are recognizing the need for effective communication and written instructions at all levels of company operation. As more training departments shift from behaviorist to cognitive approaches to training the need for writers who can translate fairly sophisticated concepts, such as statistical process control, for unsophisticated learners increases. Finding a practical method of testing writing skills is increasingly needed. This paper presents a promising approach since it requires applicants to write rather than simply identify grammatical or spelling errors in writing samples, a technique used in standardized multiple choice writing tests. It also uses a set of criteria more suited to business use than the standards frequently used to judge creative writing or other narrative prose.

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